IN THE UNITED STATES PATENTS AND TRADEMARK OFFICE

KPO-001

Applicant : Ryoichi Okuyama et al.

Title : HYDROGEN GENERATING METHOD AND HYDROGEN GENERATING SYSTEM BASED ON THE METHOD

Serial No. : 10/584,267

Filed : June 23, 2006

Group Art Unit : 1731

Examiner : Wiese, Noah S

Mail Stop Appeal Brief - Patents
Commissioner for Patents
U.S. Patents and Trademarks Office
Attention: BOARD OF PATENT APPEALS AND INTERFERENCES

May 31, 2011

APPEAL BRIEF

Sir:

Further to the Notice of Appeal of March 29, 2011, an appeal brief is filed herewith.

A credit card authorization form in the amount of $540.00 is filed herewith for the appeal brief fee.

This brief contains the following items in the order set forth below (37 C.F.R. § 41.37(c)):

I. Real Party in Interest.

II. Related Appeals and Interferences.

III. Status of Claims.

IV. Status of Amendments.

V. Summary of Claimed Subject Matter.

VI. Grounds of Rejection to be Reviewed on Appeal.

VII. Argument.

VIII. Claims Appendix.

IX. Evidence Appendix.

X. Related Procedures Appendix.

I. REAL PARTY IN INTEREST

The real party of interest is:

GS YUASA INTERNATIONAL LTD.

1, INOBABA-CHO, KISSHOIN, MINAMI-KU

KYOTO-SHI, KYOTO, JAPAN

As demonstrated by the assignment recorded at reel/frame: 018041/0716 on June 23, 2006.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

A. Total Number of Claims in Application:

There is a total of 47 claims in the application, which are identified as claims 1-10, 12-14, 16, 21-23, 27-28, 32-33, 39-40, 43, 47, 52, 55 and 58-77.

B. Status of all the claims:

1. Claims cancelled: 11, 15, 17-20, 24-26, 29-31, 34-38, 41-42, 44-46, 48-51, 53-54, 56-57.
2. Claims withdrawn from consideration but not cancelled: none.
3. Claims pending: claims 1-10, 12-14, 16, 21-23, 27-28, 32-33, 39-40, 43, 47, 52, 55 and 58-77.
4. Claims allowed: 1-10, 12, 16, 21-23, 27-28, 32-33, 39-40, 43, 47, 52 and 55.
5. Claims rejected: 13-14 and 58-77.
6. Claims objected to: none.
7. Claims on Appeal: 13-14 and 58-77.

IV. STATUS OF AMENDMENTS

An RCE was filed on October 29, 2010. No claim amendments were submitted with this filing. A final rejection was issued on January 4, 2011 and a Notice of Appeal was filed on March 29, 2011.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 13 is directed to a hydrogen generating system for generating hydrogen-containing gas by decomposing fuel containing an organic compound, the system ([0095] comprising:

a partition membrane (11, [0095], Figs. 1 and 2),

a fuel electrode (12, [0096] Figs. 1 and 2) provided on one surface of the partition membrane,

means (13, 16, 18 [0096]-[0100]) for supplying fuel containing an organic compound and water to the fuel electrode,

an oxidizing electrode (14, [0096] Figs. 1 and 2) provided on the other surface of the partition membrane (11, Fig. 2),

means (15, 17, 19, [0096] - [0100] Fig. 2) for supplying an oxidizing agent (air) to the oxidizing electrode (14), and

means (23, [0103]) for collecting hydrogen-containing gas generated on the fuel electrode and wherein the system is configured to operate in a plurality of configurations ([0015] sub-paragraphs (1) - (4)) wherein one of said configurations comprises an open circuit configuration ([0015] sub-paragraph (2)) wherein no current is supplied to either the fuel electrode or the oxidizing electrode,

wherein, in a first closed circuit configuration ([0133]) the oxidizing electrode and the fuel electrode are connected to means ([0146] potentiostat) for withdrawing electric energy from the hydrogen generating cell with the fuel electrode serving as a negative electrode and the oxidizing electrode as a positive electrode, and

voltage between the fuel electrode and the oxidizing electrode is adjusted to 200 to 600 mV ([0136]) by varying volume of electric energy withdrawn from the hydrogen generating unit so that evolution volume of the hydrogen-containing gas from the fuel electrode is adjusted.

Independent claim 14 is directed to a hydrogen generating system for generating hydrogen-containing gas by decomposing fuel containing an organic compound, the system comprising:

a partition membrane (11, [0095], Figs. 1 and 2),

a fuel electrode (12, [0096] Figs. 1 and 2) provided on one surface of the partition membrane,

means (13, 16, 18 [0096]-[0100]) for supplying fuel containing an organic compound and water to the fuel electrode,

an oxidizing electrode (14, [0096] Figs. 1 and 2) provided on the other surface of the partition membrane,

means (15, 17, 19, [0096] - [0100] Fig. 2) for supplying an oxidizing agent to the oxidizing electrode, and

means (23, [0103]) for collecting hydrogen-containing gas generated on the fuel electrode and wherein the system is configured to operate in a plurality of configurations ([0015] sub-paragraphs (1) - (4)) wherein one of said configurations comprises an open circuit configuration ([0015] sub-paragraph (2)) wherein no current is supplied to either the fuel electrode or the oxidizing electrode,

wherein in a second closed circuit configuration the oxidizing electrode and the fuel electrode are connected to means ([0146] potentiostat) for providing external electric energy ([0015] sub-paragraph (4)) with the fuel electrode serving as cathode and the oxidizing electrode as anode, and

voltage between the fuel electrode and the oxidizing electrode is adjusted to 300 to 1000 mV by varying volume of electric energy provided ([0144]) so that evolution volume of the hydrogen-containing gas from the fuel electrode is adjusted.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A) The rejections of claims 13-14, 58-66, and 68-76 under 35 U.S.C. 102(e) as being anticipated by Cropley et al. (US 6,811,905).

B) The rejection of claims 67 and 77 were rejected under 35 U.S.C. 103(a) as being unpatentable over Cropley et al. in view of Quang et al. (US 4,840,783).

VII. ARGUMENT

A) In the final Office Action, Examiner advanced, in connection with claims 13 and 14, that Cropley et al. (hereinafter Cropley) teaches a methanol fuel cell that can be used in an alternative method to produce hydrogen. The examiner further asserted that fuel cell comprises a partition membrane with electrodes on opposing sides, wherein a methanol and water fuel mixture is introduced to one electrode and oxygen is introduced to the opposing electrode.

Cropley, it was advanced, also teaches a means for supplying an oxidizing agent and fuel containing an organic compound to opposite electrodes. Cropley was asserted to teach that there is a means for collecting (discharging) methanol, water, and carbon dioxide (see column 7, lines 25-35). This means is located, it was purported, at the anode (fuel electrode) side of the fuel cell and thus would be capable of collecting hydrogen if it was generated on this electrode. Therefore, it was concluded, that

this is a functional equivalent means to that of the instant claim.

The rejection then summarized that the hydrogen generating system taught by Cropley meets all of the structural limitations of instant claims 13-14, and therefore anticipates the claims.

At first, it is to be noted that claims 13 and 14 are directed to the generation of hydrogen gas in the absence of a current being supplied to the electrodes of the claimed device. This is seen as distinguishing over the disclosure of Cropley et al.

That is to say, the methanol fuel cell of Cropley generates electricity by producing the following reactions as shown in Fig. 1, and is used as a fuel cell (DMFC).

At the anode, $CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e$

At the cathode, $3/2O_2 + 6H^+ + 6e \rightarrow 3H_2O$

Also, as shown in Fig. 1, H does not become H_2 gas. Hydrogen is involved in the above-mentioned reactions by moving through a partition membrane as H^+. In the case of considering the usage as the fuel cell (DMFC), if H^+ becomes H_2 gas, it follows that the above-mentioned reactions would not take place. Accordingly, it may be said that it is based on the assumption that the reaction of producing H_2 gas wherein H^+ is consumed, would not take place.

Conversely, the invention as defined in claim 13 generates electricity due to the above-mentioned reactions, and at the same time, generates hydrogen so as to also be "a hydrogen generating system". In claim 13, the oxygen supply is reduced so that the voltage between the fuel electrode and the oxidizing electrode is adjusted to 200-600 mV. However, as previously mentioned, in the claimed invention, it was found that the following reactions

which completely differ from the above-mentioned reactions take place, and that hydrogen is generated at the anode so as to be "a hydrogen generating system".

At the cathode, $CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$

At the anode, $6H^+ + 6e^- \rightarrow 3H_2$

Therefore, in claim 13, it is important to provide "means for collecting hydrogen-containing gas" for the anode (fuel electrode) in order to provide "a hydrogen generating system". This differentiates over the Cropley reference and further renders the anticipation rejection of this claim untenable.

In the final Office Action, it was held that "Cropley teaches that there is a means for collecting (discharging) methanol, water, carbon dioxide (see column 7, lines 25-35). This means is located at the anode (fuel electrode) side of the fuel cell and thus would be capable of collecting hydrogen if it was generated on this electrode." "Therefore, it is a functionally equivalent means to that of the instant claim." However, this opinion is not well taken.

The point of the invention of claim 13 is that hydrogen can be generated at the anode. Since Cropley does not disclose that hydrogen is generated at anode, "collecting hydrogen" cannot be expected to occur at this site and anticipation cannot be established.

Also, in Cropley, due to the above-mentioned reactions, CO_2 (carbon dioxide) is generated at anode, and CH_3OH (methanol) and H_2O (water) which are raw materials, remain, so that in order to discard or circulate them, "a means for collecting methanol, water, carbon dioxide" is provided. However, it is without merit to assert that since methanol, water, and carbon dioxide can be collected, hydrogen can be collected inasmuch as Cropley does not disclose that hydrogen is generated at anode.

Also, it can be said that "a means for collecting" differs if materials to be collected differ, so that even if hydrogen is generated in Cropley there is a significant difference between that "methanol, water, and carbon dioxide" which are unreacted reactants or wastes are collected in order to be used as the DMFC, and that "hydrogen" which is a product is collected in order to be used as "a hydrogen generating system". Therefore, it cannot be said that the "means for collecting" of claim 13 and Cropley are "functionally equivalent means".

The same holds for claim 14.

Although Cropley discloses that H_2 gas is generated at cathode (see column 15, lines 24-35), according to the description, H_2 gas is generated in the above-mentioned formulas instead of generating H_2O (water) by supplying e^- (applying an electric current) from outside without supplying oxygen to cathode, so that reaction formulas will be as follows.

At the cathode, $H^+ + 6e^- \rightarrow 3H_2$

At the anode, $CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$

Conversely, in claim 14, e^- is supplied from an external source, and due to the above-mentioned reactions, H_2 is generated at the cathode (oxidizing electrode), and at the same time, by adjusting the voltage between the fuel electrode and the oxidizing electrode to 300-1000 mV, due to the following reactions, H_2 is generated at the anode (fuel electrode) without any relation to the externally supplied e^-.

At the cathode, $CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$

At the anode, $6H^+ + 6e^- \rightarrow 3H_2$

Therefore, in order to be used as "a hydrogen generating system", providing the "means for collecting hydrogen-containing gas" for the anode (fuel electrode), is important as in the present invention of claim 13.

Also, the effect of the present invention of claim 14 is specifically described in paragraph [0226] of the specification of the present application such that the relation of the rate of hydrogen evolution with the current density applied in the test is shown in Fig. 43.

It was found that the efficiency of hydrogen evolution (efficiency of hydrogen evolution relative to electric energy supplied) becomes equal to or more than 100% (100% efficiency of hydrogen evolution is represented by the dashed line in Fig. 43) in certain areas when the current density is kept not more than 40 mA/cm^2. This suggests that it is possible to obtain hydrogen whose energy content is larger than the electric energy supplied from outside by operating the cell in those areas."

Second, the claimed means (potentiostat) for withdrawing electric energy from the hydrogen generating cell with the fuel electrode serving as a negative electrode and the oxidizing electrode as a positive electrode, has not been specifically addressed in the rejection of claim 13. Further, the means (potentiostat) for providing external electric energy to the fuel electrode serving as cathode and the oxidizing electrode as anode, recited in claim 14 has not been specifically addressed. Indeed, it is submitted that the Cropley reference fails to specifically disclose either of the above-mentioned means.

The position (erroneously) taken by the Examiner that the configuration in which the system can operate in an open circuit configuration wherein no current is supplied to either electrode is merely an intended use limitation, does not permit the remainder of the claim to be ignored. Indeed, whether or not current is supplied to either electrode is in actual fact a function of the process in which the claimed system is being

used, does not permit the above cited means (potentiostat) for withdrawing from (claim 13) or supplying (claim 14) electric energy to the hydrogen generating cell, to be ignored. These withdrawing and supplying means are structural limitations that cannot be glossed over and ignored, and must be addressed in the rejection.

The position taken by the Examiner that the system taught by Cropley could indeed have all of the needed connections for supplying current to the electrodes, is traversed. This is nothing more than conjecture and is not specifically supported by the disclosure of Cropley. The position that the claims would still meet all of the patentably weighted limitations of the instant claims because the state of use of the instantly claimed system cannot be used in distinguishing the claims, is submitted as not being well taken.

For instance, the assertion that the Cropley system would meet the requirement that no current is supplied to either electrode when the system is off and not in use, does not negate the fact that the claim calls for both open and closed configurations (viz., circuit structure) and for a specific voltage range to be established when electrical energy is withdrawn by the means (potentiostat) for withdrawing electric energy in a first closed circuit configuration (claim 13); and providing electrical energy so that a specific voltage range is established in a second closed circuit configuration (claim 14).

Therefore, each and every claimed element found in the independent claims is not found in the Cropley reference. A reversal of the anticipation rejection is therefore deemed both proper and necessary.

As explained above, claims 13 and 14 are neither disclosed in nor even remotely suggested by Cropley. Also, since claims 58-66, and 68-76 depend from claims 13 or 14, claims 58-66 and 68-76 are not anticipated by Cropley.

B) The rejection of claims 67 and 77 under 35 U.S.C. 103(a) as being unpatentable over Cropley in view of Quang et al. (hereinafter Quang) is deemed untenable in connection with the lack of anticipation.

In this rejection, the Examiner has advanced in connection with claims 67 and 77, that the claims differ from Cropley because Cropley does not teach a carbon dioxide absorbing portion for removing carbon dioxide from the produced hydrogen gas. However, it is asserted, it would have been obvious to modify Cropley in view of Quang in order to add such an absorbing portion to the system because Quang teaches a method of producing hydrogen from methanol involving an advantageous carbon dioxide absorbing portion (see claim 18). That is to say, one of ordinary skill would have been motivated to include such an absorbing portion because doing so would result in a product gas produced by the Cropley system having a higher hydrogen purity. The Examiner submits that one would have expected reasonable success in the modification because Cropley teaches that hydrogen can be produced from the inventive system and Quang teaches a method for removing carbon dioxide from hydrogen-containing gas. Therefore, claims 67 and 77 are obvious and not patentably distinct over the prior art of record.

This position is traversed in that the teachings of Quang have not been taken as whole as is required under the § 103 statute. Quang clearly discloses combining a mixture of

methanol, water and carbon dioxide in a manner to ensure that the disclosed process produces a mixture of hydrogen and carbon monoxide - c.f. hydrogen gas alone in the Cropley reference. The removal of the superfluous remaining carbon dioxide which was deliberately added as an initial ingredient, is therefore seemed self-evident, especially in light of the intention of converting the resultant gas into methane and water - see claim 18 (which is the sole section of the Quang reference relied upon by the Examiner for rejection).

The Examiner's reliance on Quang to teach the production of hydrogen from methanol is such as to not take the full disclosure and intention of Quang into consideration and further ignores the dilemma (viz., produce just hydrogen or conversely a mixture of hydrogen and carbon monoxide for further reaction) that the reader of ordinary skill would face when the teachings of Quang were considered in connection with those of Cropley.

In regard to claims 67 and 77, Quang was further cited to show a carbon dioxide absorbing portion. Claims 67 and 77 depend from claims 13 and 14, which are not disclosed by Cropley as explained above. Since Quang does not rectify the deficiency of Cropley claims 67 and 77 depending from claims 13 and 14 are not obvious in light of Cropley and Quang.

As explained above, claims 13, 14 and 58-77 are patentable over the cited references.

Favorable reconsideration and a reversal of both rejections are respectfully solicited.

Respectfully Submitted,

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VIII. CLAIMS APPENDIX

13. A hydrogen generating system for generating hydrogen-containing gas by decomposing fuel containing an organic compound, the system comprising:

a partition membrane,

a fuel electrode provided on one surface of the partition membrane,

means for supplying fuel containing an organic compound and water to the fuel electrode,

an oxidizing electrode provided on the other surface of the partition membrane,

means for supplying an oxidizing agent to the oxidizing electrode, and

means for collecting hydrogen-containing gas generated on the fuel electrode and wherein the system is configured to operate in a plurality of configurations wherein one of said configurations comprises an open circuit configuration wherein no current is supplied to either the fuel electrode or the oxidizing electrode,

wherein, in a first closed circuit configuration the oxidizing electrode and the fuel electrode are connected to means for withdrawing electric energy from the hydrogen generating cell with the fuel electrode serving as a negative electrode and the oxidizing electrode as a positive electrode, and

voltage between the fuel electrode and the oxidizing electrode is adjusted to 200 to 600 mV by varying volume of electric energy withdrawn from the hydrogen generating unit so that evolution volume of the hydrogen-containing gas from the fuel electrode is adjusted.

14. A hydrogen generating system for generating hydrogen-containing gas by decomposing fuel containing an organic compound, the system comprising:

a partition membrane,

a fuel electrode provided on one surface of the partition membrane,

means for supplying fuel containing an organic compound and water to the fuel electrode,

an oxidizing electrode provided on the other surface of the partition membrane,

means for supplying an oxidizing agent to the oxidizing electrode, and

means for collecting hydrogen-containing gas generated on the fuel electrode and wherein the system is configured to operate in a plurality of configurations wherein one of said configurations comprises an open circuit configuration wherein no current is supplied to either the fuel electrode or the oxidizing electrode,

wherein in a second closed circuit configuration the oxidizing electrode and the fuel electrode are connected to means for providing external electric energy with the fuel electrode serving as cathode and the oxidizing electrode as anode, and

voltage between the fuel electrode and the oxidizing electrode is adjusted to 300 to 1000 mV by varying volume of electric energy provided so that evolution volume of the hydrogen-containing gas from the fuel electrode is adjusted.

58. The hydrogen generating system as described in claim 13 wherein voltage between the fuel electrode and the oxidizing electrode and/or the evolution volume of hydrogen-containing gas

are/is adjusted by varying the supply volume of the oxidizing agent.

59. The hydrogen generating system as described in claim 13 wherein voltage between the fuel electrode and the oxidizing electrode and/or the evolution volume of hydrogen-containing gas are/is adjusted by varying the concentration of the oxidizing agent.

60. The hydrogen generating system as described in claim 13 wherein voltage between the fuel electrode and the oxidizing electrode and/or the evolution volume of hydrogen-containing gas are/is adjusted by varying the supply volume of fuel containing an organic compound and water.

61. The hydrogen generating system as described in claim 13 wherein voltage between the fuel electrode and the oxidizing electrode and/or the evolution volume of hydrogen-containing gas are/is adjusted by varying the concentration of fuel containing an organic compound and water.

62. The hydrogen generating system as described in claim 13 wherein the operation temperature is not higher than 100°C.

63. The hydrogen generating system as described in claim 13 wherein the partition membrane is a proton conducting solid electrolyte membrane.

64. The hydrogen generating system as described in claim 13 wherein a catalyst applied to the fuel electrode is made of

platinum-ruthenium alloy supported by carbon powder serving as a base.

65. The hydrogen generating system as described in claim 13 wherein a catalyst applied to the oxidizing electrode is made of platinum supported by carbon powder serving as a base.

66. The hydrogen generating system as described in claim 13 comprising means for circulating fuel containing an organic compound and water.

67. The hydrogen generating system as described in claim 13 comprising a carbon dioxide absorbing portion for absorbing carbon dioxide contained in the hydrogen-containing gas.

68. The hydrogen generating system as described in claim 14 wherein voltage between the fuel electrode and the oxidizing electrode and/or the evolution volume of hydrogen-containing gas are/is adjusted by varying the supply volume of the oxidizing agent.

69. The hydrogen generating system as described in claim 14 wherein voltage between the fuel electrode and the oxidizing electrode and/or the evolution volume of hydrogen-containing gas are/is adjusted by varying the concentration of the oxidizing agent.

70. The hydrogen generating system as described in claim 14 wherein voltage between the fuel electrode and the oxidizing electrode and/or the evolution volume of hydrogen-containing gas

are/is adjusted by varying the supply volume of fuel containing an organic compound and water.

71. The hydrogen generating system as described in claim 14 wherein voltage between the fuel electrode and the oxidizing electrode and/or the evolution volume of hydrogen-containing gas are/is adjusted by varying the concentration of fuel containing an organic compound and water.

72. The hydrogen generating system as described in claim 14 wherein the operation temperature is not higher than 100°C.

73. The hydrogen generating system as described in claim 14 wherein the partition membrane is a proton conducting solid electrolyte membrane.

74. The hydrogen generating system as described in claim 14 wherein a catalyst applied to the fuel electrode is made of platinum-ruthenium alloy supported by carbon powder serving as a base.

75. The hydrogen generating system as described in claim 14 wherein a catalyst applied to the oxidizing electrode is made of platinum supported by carbon powder serving as a base.

76. The hydrogen generating system as described in claim 14 comprising means for circulating fuel containing an organic compound and water.

77. The hydrogen generating system as described in claim 14 comprising a carbon dioxide absorbing portion for absorbing carbon dioxide contained in the hydrogen-containing gas.

IX. EVIDENCE APPENDIX

None

X. RELATED PROCEEDINGS APPENDIX

None - There are no related proceedings